AEA

Automatic Urban & Rural Network: Assessment of Siting Criteria

Report to the Department for Environment, Food and Rural Affairs, Scottish Government, Welsh Assembly Government and the DoE in N. Ireland

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Executive summary

The sites currently in the Automatic Urban and Rural Network (AURN) have been assessed for compliance with the requirements of the EU Directive on ambient air quality 2008/50/EC. This places requirements on site location and sampling criteria, which must be met by all sites used to ensure the UK's compliance with the Directive.

Of the 127 sites in the network as of July 2009 and several which have yet to be commissioned into the network, eight have been identified as not fully meeting the requirements. These are:

Brighton Roadside
Bristol Old Market
Bury Roadside
Great Dun Fell
Leicester Centre
London Cromwell Road 2
Sandwell West Bromwich
Weybourne

The reasons for non-compliance are described and possible solutions provided.

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1 Introduction

A new air quality Directive (2008/50/EC) of the European Parliament and of the Council of 21st May 2008, on ambient air quality and cleaner air for Europe) was adopted in June 2008. The new Directive, which comes into force in mid-2011, will streamline the European Union's air quality legislation with a single integrated instrument. The Directive defines the siting criteria for monitoring sites on a macro- and micro scale. This document summarises a review of the current AURN sites against these requirements and identifies sites that are not compliant.

Many sites are affiliated to the network, and were in operation for local air quality purposes prior to becoming part of the network. It is important that the suitability of these sites is assessed and documented to ensure the UK's continued compliance with the Directive. Over time, local site conditions do change, for example new buildings, vegetation or industrial development. Some sites have been discontinued, replaced or relocated, or have been upgraded as required.

The Directive provides for assessment of air quality at all locations in a Member State, except those prescribed in Annex 3, ie where the public have no access, where occupational health and safety legislation is applicable, and on the carriageway or central reservation of roads (though York Fishergate is an example where the central reservation is accessed by the public and therefore the Directive is applicable). There are requirements for the protection of human health, as well as for vegetation and ecosystems. The Directive defines separate criteria for ozone, recognizing the long-range transport mechanism that influences ambient ozone concentrations.

2 Directive Requirements

2.1 Background

The AURN has its roots in the original Statutory Urban Network (SUN) and the Rural network, with the first site established at Sibton in 1973. Several of the sites considerably pre-date the relevant Directives, and have been retained in the network to provide long-term information on air quality, and therefore may not meet the current requirements. A more thorough history is given in Air Pollution in the UK: 2007 http://www.airquality.co.uk/annualreport/annualreport2007.php

The network has grown in response to legislative, scientific, technical and policy requirements over the years. There are currently a total of 127 sites measuring nitrogen dioxide, sulphur dioxide, ozone, carbon monoxide and airborne particles (PM_{10} and $PM_{2.5}$). Currently, 66 of the sites in operation are affiliated to the network, i.e. are owned and operated by non-central government organisations (mainly local authorities). These sites may have been installed originally to meet the requirements of the review and assessment process for local air quality. In order to ensure the UK's compliance with the EU air quality Directives, it is important that the sites are sited according to the specified requirements (Directive 2008/50/EC, Annex III and VIII-ozone)

Sites are defined by the following categories:

Rural	Sites more than 5 kilometres from significant residential areas
Urban Background	Places representative of exposure of the general urban population
Roadside	2-10 metres from the kerb
Kerbside	Within 1 metre of the kerb
Industrial	Site in residential area downwind of specific source

2.2 Macroscale Requirements

For pollutants other than ozone, the macroscale siting requirements are defined for protection of human health, and for protection of vegetation and ecosystems. These requirements are intended to ensure that sites are representative of the areas in which they are located, are not unduly affected by specific processes (except for industrially focussed sites), and are typical of areas where the population may be exposed for a significant time.

The Directive defines the requirements as follows:

1. Protection of human health

(a) Sampling points directed at the protection of human health shall be sited in such a way as to provide data on the following:

- *the areas within zones and agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s),*

- *levels in other areas within the zones and agglomerations which are representative of the exposure of the general population,*

(b) Sampling points shall in general be sited in such a way as to avoid measuring very small micro-environments in their immediate vicinity, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality for a street segment no less than 100 metre length at traffic-orientated sites and at least 250 × 250 metres at industrial sites, where feasible;

(c) Urban background locations shall be located so that their pollution level is influenced by the integrated contribution from all sources upwind of the station. The pollution level should not be dominated by a single source unless such a situation is typical for a larger urban area. Those sampling points shall, as a general rule, be representative for several square kilometres;

(d) Where the objective is to assess rural background levels, the sampling point shall not be influenced by agglomerations or industrial sites in its vicinity, i.e. sites closer than five kilometres;

(e) Where contributions from industrial sources are to be assessed, at least one sampling point shall be installed downwind of the source in the nearest residential area. Where the background concentration is not known, an additional sampling point shall be situated within the main wind direction;

(f) Sampling points shall, where possible, also be representative of similar locations not in their immediate vicinity;

(g) Account shall be taken of the need to locate sampling points on islands where that is necessary for the protection of human health.

2. Protection of vegetation and natural ecosystems

Sampling points targeted at the protection of vegetation and natural ecosystems shall be sited more than 20 kilometres away from agglomerations or more than 5 kilometres away from other built-up areas, industrial installations or motorways or major roads with traffic counts of more than 50 000 vehicles per day, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality in a surrounding area of at least 1000 square kilomtres. A Member State may provide for a sampling point to be sited at a lesser distance or to be representative of air quality in a less extended area, taking account of geographical conditions or of the opportunities to protect particularly vulnerable areas.

Account shall be taken of the need to assess air quality on islands.

It is of course difficult to establish that a site is located at the point where the highest concentration will be encountered, as (except for roadside and industrial sites) the site needs to be located away from specific sources such as traffic or incinerators. In many cases, site selection would have been backed up by diffusion tube surveys or modelling, but in most cases, practical constraints have a more significant contribution to site location. This is recognised in the microscale requirements of the Directive.

2.3 Microscale Requirements

The microscale requirements are intended to ensure that the measurements made at each site are representative of that location, and no local adverse conditions will compromise the integrity of the data. The requirements are defined as:

In so far as is practicable, the following shall apply:

- *the flow around the inlet sampling probe shall be unrestricted (free in an arc of at least 270°) without any obstructions affecting the airflow in the vicinity of the sampler (normally some metres away from buildings, balconies, trees and other obstacles and at least 0.5 metres from the nearest building in the case of sampling points representing air quality at the building line),*

- *in general, the inlet sampling point shall be between 1.5 metres (the breathing zone) and 4 metres above the ground. Higher positions (up to 8 metres) may be necessary in some circumstances. Higher siting may also be appropriate if the station is representative of a large area,*

- *the inlet probe shall not be positioned in the immediate vicinity of sources in order to avoid the direct intake of emissions unmixed with ambient air,*

— *the sampler's exhaust outlet shall be positioned so that recirculation of exhaust air to the sampler inlet is avoided,*

— *for all pollutants, traffic-orientated sampling probes shall be at least 25 metres from the edge of major junctions and no more than 10 metres from the kerbside.,*

The Directive recognises that practical constraints such as power supplies, security, safety and planning may be taken into account. These factors are frequently the dominant factor in deciding where monitoring sites can be located, and monitoring cannot always be carried out at the most favourable location. Sites located in existing buildings very often have the sample inlet mounted on the wall of the building, thus limiting the angle of airflow around the inlet, b ut this does not necessarily mean the site is unrepresentative. Compromises are inevitable but these should not be allowed to overly degrade data quality. Regular review of site suitability is necessary, and is currently carried out by the QA/QC Unit every six months. The Directive requires that site location reviews are carried out regularly, and it is intended that this process will address this requirement. It is suggested that site photographs should be occasionally updated on the AURN information site (www.bv-aurnsiteinfo.co.uk) in order to help identify local changes. LSOs are also encouraged to report anything that might affect the measurements from the site.

2.4 Ozone Criteria

The siting criteria for ozone sites are defined in Annex VIII of the Directive

	Objectives of measurement	Representative	Macroscale criteria
Urban	Protection of human health: to assess the exposure of the urban population to ozone, i.e.where population density and ozone oncentration are relatively high and representative of the exposure of the general population	A few km^2	Away from the influence of local emissions such as traffic, petrol stations, etc.; vented locations where well mixed levels can be measured; locations such as residential and commercial areas of cities, parks (away from the trees), big streets or squares with very little or no traffic, open areas characteristic of educational, sports or recreation facilities
Suburban	Protection of human health and vegetation: to assess the exposure of the population and vegetation located in the outskirts of the agglomeration, where the highest ozone levels, to which the population and vegetation are likely to be directly or indirectly exposed occur	Some tens of km^2	At a certain distance from the area of maximum emissions, downwind following the main wind direction/directions during conditions favourable to ozone formation; where population, sensitive crops or natural ecosystems located in the outer fringe of an agglomeration are exposed to high ozone levels; where appropriate, some suburban stations also upwind of the area of maximum emissions, in order to determine the regional background levels of ozone
Rural	Protection of human health and vegetation: to assess the exposure of population, crops and natural ecosystems to sub-regional scale ozone concentrations	Sub-regional levels (some hundreds of km^2)	Stations can be located in small settlements and/or areas with natural ecosystems, forests or crops; representative for ozone away from the influence of immediate local emissions such as industrial installations and roads;at open area sites, but not on summits of higher mountains
Rural background	Protection of vegetation and human health: to assess the exposure of crops and natural ecosystems to	Regional/ national/ continental	Station located in areas with lower population density, e.g. with natural ecosystems, forests, at a distance

	regional-scale ozone concentrations as well as exposure of the population	levels (1 000 to 10 000 km^2)	of at least 20 km from urban and industrial areas and away from local emissions; avoid locations which are subject to locally enhanced formation of ground-near inversion conditions, also summits of higher mountains; coastal sites with pronounced diurnal wind cycles of local character are not recommended.

For microscale criteria, those defined for the other pollutants in 2.3 above apply, with the additional requirement that sites should be more than 10 metres from roads, increasing with traffic density.

Ladybower is classed as a rural background site, as it is at least 20 kilometres from the Greater Manchester agglomeration and is representative of a considerable area within the Peak District National Park. The air quality observed at this site, however, is influenced by industrial emissions from urban areas under certain meteorological conditions. Glazebury too, is affected by local emissions, in this case from major roads, and is therefore classified as rural.

2.5 Sites yet to be Affiliated

The process of updating the network is still ongoing, and several sites have therefore yet to be added to the network to ensure Directive compliance. The process of site selection included assessment against the requirements of the Directive, and sites approved for affiliation will be compliant. Some minor site specific requirements (eg sample inlet location) may need to be checked following installation of any additional equipment required for affiliation.

3 Site assessments

The process of assessing the site compliance used the following inputs:

- Site criteria assessed at 6-monthly QA/QC audits carried out by AEA staff. A questionnaire was appended to the audit spreadsheet which recorded site information such as sample height, local sources etc
- Information available on the AURN site information website, including maps and photographs
- Google Earth, useful for determining distances to roads, junctions, etc and general topography and urban layout
- Specific information based on observations of staff who have visited the sites recently

Each site was then considered individually against the Directive requirements, and those not compliant are listed below:

Site	Reason for noncompliance	Comments
Brighton Roadside	Site on major road junction	Location not representative of area
Bristol Old Market	Site on major road junction	Location not representative of area
Bury Roadside	Site within major road junction	Site also too far from carriageway to be Roadside
Great Dun Fell	Site in elevated location (900m asl)	Site originally intended for reseach purposes
Leicester Centre	Site between two large office blocks preventing free air movement	Location not representative of area
London Cromwell Road 2	Site on major road junction	Site relocated from more suitable location in 1998
Sandwell West Bromwich	Site in car park on top floor	Not representative of local area; may be affected by traffic in car park
Weybourne	Site on coast	Prevailing weather conditions so near sea may affect concentrations

In addition, several sites were identified to not be fully compliant with the Directive, and site operators/equipment service units are to consider making improvements to enhance compliance:

Glasgow City Chambers, Oxford Centre Roadside, Sibton: Check sample inlets are more than 0.5 metres from side of enclosure/building façade.

There are several sites (particularly Roadside and those in existing buildings) where the sample inlet is restricted to less than 270 degrees. It is not thought that these significantly affect measured concentrations. Several sites sample at heights greater than 8m (e.g. Glasgow City Chambers), but this is allowed where considered appropriate. All sites in the AURN comply with this. Many traffic-orientated sites (e.g. Exeter Roadside) are influenced by standing traffic, but this does not adversely affect the representation of the area in general.

There are several Industrial sites in the AURN-Grangemouth, Middlesbrough, Port Talbot Margam and Scunthorpe Town. Of these, only Port Talbot Margam is in prevailing wind from the process of interest, as the others are located close to the sea, and there is no significant population exposure downwind of the sites. There are few meteorological measurements available at AURN sites to accurately assess wind direction; reliable data need to be obtained from the most appropriate meteorological station, which may be some distance away.

We carry out assessments of data quality from a significant number of non-AURN monitoring sites where the air quality objectives may be exceeded. Where such exceedences may affect the status of the relevant agglomeration or zone, consideration is given to affiliate these sites into the AURN. Where a site is a possible candidate for affiliation, we would then look in detail at whether the site is compliant with the more detailed siting requirements of the Directive.

4 Recommendations

It is important that the UK monitoring network meets the requirements of the Directive. Of the sites identified as not being compliant, Brighton Roadside, Bristol Old Market, Great Dun Fell, London Cromwell Road 2 and Weybourne are not specifically required for Directive compliance. Bury Roadside, Sandwell West Bromwich and Leicester Centre, however, are required as prescribed in Annex V and so will require relocation or replacement should the current sites be closed.

London Cromwell Road 2 is currently one of four Roadside sites operating in London, and three are required under the Directive. However, this figure includes Southwark Roadside, which has not operated since early 2006, and no information on its reinstatement has been received.

Sandwell West Bromwich is in line for installation of a second FDMS unit to meet Directive requirements for particulate matter in the West Midlands Agglomeration. Unfortunately the enclosure is unsuitable for the additional equipment, and an alternative location is currently being sought for affiliation. Sandwell West Bromwich will therefore be deaffiliated in due course.

Leicester Centre is probably the most significant problem, as relocating the site may be a difficult and expensive operation. There are no urban background monitoring sites currently in operation in Leicester.

Appendices

Appendix 1

Site Details

Site	Winter 2009 classification assessment	Location details
Aberdeen	Urban Background	Errol Place. Close to city centre and approximately 80 metres from main road.
Aberdeen Union Street Roadside	Roadside	Located on north side of A9013 Union Street approximately 7m from the roadside (ignoring bus lane).
Aston Hill	Rural Background	On the summit of a hill with clear views of surrounding arable farmland.
Auchencorth Moss	Rural	Situated in the middle of a field, roughly 1300m to nearest road
Barnsley 12	Urban Background	Municipal building in centre of a coal mining town. 200 m from an arterial road.
Barnsley Gawber	Urban Background	Single storey brick building located adjacent to open reclaimed landfill site at edge of urban area. Approximately 2 miles NW of town centre.
Bath Roadside	Roadside	Located on the A4 London Road with traffic flow approximately 22 000 vehicles per day. Relocated Apr 2005.
Belfast Centre	Urban Background	Pedestrianised street (Lombard St) 25 m from major road.
Billingham	Urban Background	Residential area. A council depot with a large complex of chemical / manufacturing plant 1-3 km to the south.
Birmingham Tyburn	Urban Background	Situated in the Car Park of the Council Office's off Tyburn Road.
Birmingham Tyburn Roadside	Roadside	Roadside Site just approximately 60m from the Tyburn Site. Located on Tyburn Road.
Blackburn Darwen Roadside	Roadside	Located in Darwen in front of Darwen Vale School. Inlets are 10m from the kerbside of the A666 in close proximity to J4 of M65 link road.
Blackpool Marton	Urban Background	Stanley School
Bottesford	Rural Background	1 km from Bottesford village on open farmland. 1 km south of A52.
Bournemouth	Urban Background	Grass verge within grounds of Portchester School near teaching block. Nearest road is Shepherds Way 48 metres NW of trailer in residential area.
Brighton Preston Park	Urban Background	First floor of a Pavillion building in the middle of Preston Park in the residential area north of the town. 100 m from the nearest road A23.
Brighton Roadside	Urban Background	Junction of Marlborough Place (A23) with Church Street. Mainly taxis and buses. Traffic flow approximately 10 000 vehicles/day
Bristol Old Market	Urban Background	Roadside site on the Old Market roundabout with traffic flow approximately 30 000 vehicles per day.
Bristol St Paul's	Urban Background	Situated in the grounds of a nursery school at Prince's Street. Immediate surroundings are residential properties.
Bury Roadside	Roadside	Located 30m from M62 in the grounds of Junction 17 roundabout. Traffic flow approximately 200 000 vehicles per day.
Bush Estate	Rural	On a flat plain between hills. Site surrounded by open and forested land. ITE buildings nearby.
Cambridge Roadside	Roadside	First floor of Mandela House facing Regents Street with traffic flow approximately 9 000 vehicles per day.
Camden Kerbside	Kerbside	Located on the kerb of the A41 Great North Way Swiss Cottage. Traffic flow more than 50 000 vehicles per day.
Canterbury	Urban Background	Western edge of Chaucer Technology School in Urban Background area. Open field to the west railway line 63m housing estate 92m nearest road 27m.
Cardiff Centre	Urban Background	Pedestrianised street (Frederick Street) 190 m from major road.
Carlisle Roadside	Roadside	Located on the south side of the A595 Castle Way approximately 7m from the kerbside of Paddy's Market.
Charlton Mackrell	Rural Background	Situtated in a field approximately 500m west of the village of Charlton Mackrell and 200m north of a rail line.
Chepstow A48	Roadside	Located on north side of A48 Newport Road approximately 6m from the kerbside.
Chesterfield	Urban Background	Adjacent to Queens Park Annexe Pavillion Queens Park Annexe Chesterfield

Chesterfield Roadside	Urban Background	Adjacent to number 461 Chatsworth Road, Chesterfield
Coventry Memorial Park	Urban Background	Memorial Park at Earlsdon in aviary building. Two road nearby: A429 115m and B4113 245m.
Cwmbran	Urban Background	Located in Croesyceiliog Comprehensive School
Derry	Urban Background	Within boundary of urban parkland called Brook Park.
Dumfries	Roadside	The sample inlet is 5 metres from the kerb of Buccleuch Street a busy ring road round the centre of town 50 metres west of traffic lights.
Eaglescliffe	Urban Background	Located just off of Urlay Nook Road at the point where it crosses Marion Avenue.
Edinburgh St Leonards	Urban Background	Located in the middle of a small park in the east of the city. About 40m from the nearest road and 5m from the St Leonard Health Centre Car Park
Eskdalemuir	Rural Background	Situated on open moorland adjacent (500 m) to Met Office Laboratory.
Exeter Roadside	Roadside	Located 3m from the kerb of Queen's Street. Traffic flow approximately 10 000 vehicles per day.
Fort William	Urban Background	The Nevis Centre Camanachd Crescent Fort William
Great Dun Fell	Rural Background	Near mountain summit and often above the cloud base.
Glasgow Centre	Urban Background	City centre pedestrianised area bounded by main traffic (Argyle Street) to north and bus terminus to far south (Howard Street).
Glasgow City Chambers	Urban Background	Central city near-kerbside location (8m from road). Partially residential area but with large traffic volumes in surrounding areas.
Glasgow Kerbside	Kerbside	Kerbside in Hope Street 20m from busy junction of Hope Street with Argyle Street. Also 4m from entrance of road traffic access to railway station.
Glazebury	Rural Background	On open flat ground in horticultural area between conurbations.
Grangemouth	Industrial	Park on the edge of a housing estate. BP refineries 300m north and main road complex 250m.
Haringey Roadside	Roadside	Located at the kerbside on Tottenham High Road. Average flow of 39 000 vehicle per day.
Harwell	Rural	Site adjacent to UKAEA Harwell research laboratories which is surrounded by flat cereal fields. The busy A34 is nearby.
High Muffles	Rural Background	Hilly moorland and forestry plantation.
Horley	Urban Background	Michael Crescent in a residential area of Horley approximately 1.5km from the runway at Gatwick Airport.
Hull Freetown	Urban Background	Northern edge of car park to north of city centre. Road 50m to south with 15 000 vehicles per day.
Inverness	Roadside	On a path to Cameron Square and 4 metres from Telford Street. Predominantly residential area with a retail business park 250m.
Ladybower	Rural Background	Adjacent to forested area overlooking reservoir in Peak National Park.
Leamington Spa	Urban Background	In a single storey building 50m from roads and 100m from the town's main through road.
Leeds Centre	Urban Background	Open area (Queens Square Court) 30 m from major road.
Leeds Headingley Kerbside	Kerbside	Located on the east side of the A660 Headingley Lane. Sample inlet approximately 1m from the kerbside.
Leicester Centre	Urban Background	Pedestrianised area at New Walk Centre Welford Place.
Leominster	Urban Background	Located in school playground on the edge of town
Lerwick	Urban Background	2.5km SW of Lerwick centre with some housing less than 1 km from the site
Liverpool Queen's Drive R/S	Roadside	Located north of the A5058 Queens Drive Walton Dual Carriageway approximately 9m from the nearside carriageway.
Liverpool Speke	Roadside	Situated in the North East corner of the grounds of St Christophers Primary School. 10m from the nearest road Tarbock Road.
London Bexley	Urban Background	Community centre car park off Bridge Road in residential area of North End.
London Bloomsbury	Urban Background	Land at Russell Square Gardens (south-east quadrant). 35 m from kerbside.
London Cromwell Road 2	Roadside	4m from Cromwell Road within Wildlife Gardens of Natural History Museum.
London Eltham	Urban Background	Situated near a golf course and school on the north side of Bexley Road.
London Haringey	Urban Background	Located in buildings in a park in Crouch End.
London Harlington	Urban Background	Located in grounds of Imperial College Sports Facility in Harlington. 300 m from outskirts of Harlington and 1 km from Heathrow Airport perimeter road
London Hillingdon	Urban	Urban Background residential area approximately 30 metres from M4 motorway.

	Background	
London Marylebone Road	Roadside	Situated 1 m from the busy Marylebone Road in the street canyon with traffic flows of 50 000 vehicles per day.
London Harrow Stanmore	Urban Background	Harrow - Aylward Schoo,l Stanmore
London N. Kensington	Urban Background	Background site at Sion Manning RC Girls School in North Kensington.
London Teddington	Urban Background	Monitoring site at the National Physical Laboratory. Close to parkland.
London Westminster	Urban Background	In mortuary car park. Mixed commercial and residential area approx 15 metres from junction of Regency Street and Horseferry Road.
Lough Navar	Rural	Clearing within a forestry plantation.
Lullington Heath	Rural	On a high plateau 5 km from the south coast. Immediate area is a NCC heathland.
Mace Head	Rural Background	Open flat land on the Atlantic coast.
Manchester Piccadilly	Urban Background	Located in Piccadilly Gardens in busy city centre. 20m from the nearest road.
Manchester South	Urban Background	Single storey building within airport boundary. 65m from nearest road. 1km from runway of Manchester Airport.
Market Harborough	Rural Background	Located in arable farmland approximately 300m from nearest small road and 2km from the village of Stockerston.
Middlesbrough	Urban Background	Situated in a residential area near Longlands College of Further Education.
Narberth	Rural Background	Situated on arable farmland in South West Wales
Newcastle Centre	Urban Background	Located in St Mary's Place Car Park near the Civic Centre.
Newcastle Cradlewell R/S	Roadside	Located on the west side of the A1058 Jesmond Road. Sample inlet approximately 2m from the kerbside.
Newport	Urban Background	Located in the grounds of St Julian's School on the NW corner of the school. Approximately 60m south of lane 1 of the M4.
Northampton	Urban Background	Within grounds of University College Northampton close to main entrance next to Research Centre. 45 metres from nearest main road (Boughton Green Rd)
Norwich (new)		
Nottingham Centre	Urban Background	Situated in pedestrianised street market. Approximately 30m from city centre through-route traffic.
Oxford Centre R/S	Roadside	Situated 3m above the pavement of St Aldate's which is a busy shopping Street.
Oxford St Ebbes	Urban Background	Located in the playground of St Ebbes First School.
Plymouth Centre	Urban Background	Pedestrianised zone in city centre (Armada Way).
Port Talbot Margam	Urban Background	Located on Grass Area outside fire station on Cardiff Road with rail line running closely parallel to the road.
Portsmouth	Urban Background	Located in the playground of Gatcombe Park Infant School at the point of Curtis Mead crossing De Lisle Close.
Preston	Urban Background	On area of cleared land situated within terraced housing development on the East side of town centre.
Reading New Town	Urban Background	Located in a cemetery in the residential east of the city. The busy A4 and A329 roads are approximately 100m from the site.
Rochester Stoke	Rural	North corner of playing field in Lower Stoke village primary school. 90m from buildings 100m from residential street on the rural Isle of Grain.
Salford Eccles	Urban Background	Situated on the corner of St Mary's Road and Church Road.
Saltash Roadside	Roadside	Situated in the car park at the back of the Co Op Funeral Directors off Caltington Road, site is backing on to New Road.
Sandwell West Bromwich	Urban Background	First floor level of car park at rear of building. 100m from main high street and overlooks an empty industrial site.
Sandy Roadside	Roadside	London Road Sandy. Close to A1 dual carriageway
Scunthorpe Town	Industrial	On grassy area in mixed industrial / commercial / residential area. Cabin is along Roland Road close to Doncaster Road in the north of Scunthorpe, to the east of steelworks
Sheffield Centre	Urban Background	Located at the junction of Charter Row and Furnival Gate. 30m from road with 20 000 cars per day.
Sheffield Tinsley	Urban Background	Near community centre in a mixed residential / industrial area 200 m from the M1.
Sibton	Rural Background	Open flat cereal farmland. Woodland to the north west.
Southend-on-Sea	Urban Background	Within urban public park in residential area. Nearest road (Chalkwell Avenue) 77 metres east and London Road 160 metres north.
Southampton Centre	Urban Background	Open grassy area at junction between Brinton's Road and Northam Road.
Southwark Roadside	Roadside	A kerbside site on the Old Kent Road. Traffic flow approximately 50 000 vehicles per day.

St Osyth	Rural	Situated in an Environment Agency water pumping station, off Beach Lane, 1.5km from Point Clear and 1km from the coast.
Stanford-le-Hope Roadside	Roadside	Located at the end of Abbotts Hall Chase, Site is less than 5m from A1014 The Manorway Dual Carridgeway.
Stoke-on-Trent Centre	Roadside	Situated in central business district. Close to ring road junction on bus route and approach to multi-storey car park in town centre.
Strath Vaich	Rural Background	Remote hilly moorland used for sheep-grazing.
Sunderland Silksworth	Roadside	Located in the entrance to a sports centre just off Silksworth Lane.
Swansea Roadside	Roadside	5m from kerbside of the Carmarthen Road (A483)
Thurrock	Urban Background	Approximately 20m from busy road and main line railway line.
Tower Hamlets Roadside	Roadside	On the A11 Mile End Road on the Queen Mary and Westfield College buildings.
Walsall Willenhall	Urban Background	Adjacent to green area in urban residential area.
Warrington	Urban Background	Sacred Heart Primary School, Warrington
Weybourne	Rural Background	North coast of Norfolk. 1 mile west of nearest settlement. Nearest town Holt 6 km South. Norwich is 30 miles South.
Wicken Fen	Rural	On the edge of Wicken Fen. The surrounding land is flat barely above sea level and predominantly agricultural.
Wigan Centre	Urban Background	Deanery High School Frog Lane
Wirral Tranmere	Urban Background	Victoria Park Community Garden Bebington Road. Area has houses flats and some business and retail outlets. 50m from 2 lane urban road.
Wrexham	Roadside	Located just beyond perimeter of school grounds. Predominantly residential area approximately 5m from Victoria Road.
Yarner Wood	Rural Background	Undulating moorland with semi-natural broadleaved woodland.
York Bootham	Urban Background	Located in museum car park to the north west of city centre
York Fishergate	Kerbside	Located on traffic island on A19 into city centre

Appendix 2

AURN Compliance with EU Directive-Summary

England

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Barnsley 12	Yes	Yes	-	
Barnsley Gawber	Yes	Yes	Yes	
Bath Roadside	Yes	Yes	-	
Billingham	Yes	Yes	-	
Birmingham Acocks Green	Yes	-		Not yet installed; microscale requirements not yet fully assessed
Birmingham Centre	Yes	Yes	Yes	
Birmingham Tyburn	Yes	Yes	Yes	
Blackburn Roadside	Yes	Yes	-	
Blackpool Marton	Yes	Yes	Yes	
Bottesford	Yes	Yes	Yes	
Bournemouth	Yes	Yes	Yes	
Brighton Preston Park	Yes	Yes	Yes	
Brighton Roadside	No	Yes	-	Site on major road junction
Bristol Old Market	No	Yes	-	Site on major road junction
Bristol St Paul's	Yes	Yes	Yes	
Bury Roadside	No	Yes	-	Site on major road junction. Site also too far from carriageway to be Roadside
Cambridge Roadside	Yes	Yes	-	
Canterbury	Yes	Yes	Yes	
Carlisle Roadside	Yes	Yes	-	
Charlton Mackrell	Yes	Yes	Yes	
Chatham Roadside	Yes	-	-	Not yet installed; microscale requirements not yet fully assessed
Chesterfield	Yes	Yes	-	
Chesterfield Roadside	Yes	Yes	-	
Coventry Memorial Park	Yes	Yes	Yes	
Eastbourne	Yes	Yes	-	
Exeter Roadside	Yes	Yes	Yes	
Glazebury	Yes	Yes	Yes	
Great Dun Fell	Yes	Yes	No	Site originally intended for research purposes
Harwell	Yes	Yes	Yes	

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Harwell Partisols	Yes	Yes	-	
High Muffles	Yes	Yes	Yes	
Horley	Yes	Yes	-	
Hull Freetown	Yes	Yes	Yes	
Ladybower	Yes	Yes	Yes	
Leamington Spa	Yes	Yes	Yes	
Leeds Centre	Yes	Yes	Yes	
Leeds Headingley Roadside	Yes	Yes	-	
Leicester Centre	No	Yes	Yes	Site surrounded by tall buildings preventing representative sampling
Leominster	Yes	Yes	Yes	
Lincoln Roadside	Yes	-	-	Not yet installed; microscale requirements not yet fully assessed
Liverpool Queen's Drive Roadside	Yes	Yes	-	
Liverpool Speke	Yes	Yes	Yes	
Lullington Heath	Yes	Yes	Yes	
Manchester Piccadilly	Yes	Yes	Yes	
Manchester South	Yes	Yes	Yes	
Market Harborough	Yes	Yes	Yes	
Middlesbrough	Yes	Yes	Yes	
Newcastle Centre	Yes	Yes	Yes	
Newcastle Cradlewell Roadside	Yes	Yes	-	
Northampton	Yes	Yes	Yes	
Norwich Centre	Yes	-	-	Not yet installed; microscale requirements not yet fully assessed
Nottingham Centre	Yes	Yes	Yes	
Oxford Centre Roadside	Yes	Yes	-	Check sample inlets are more than 0.5m from side of enclosure/building façade.
Oxford St Ebbes	Yes	Yes	Yes	
Plymouth Centre	Yes	Yes	Yes	
Portsmouth	Yes	Yes	Yes	
Preston	Yes	Yes	Yes	
Reading New Town	Yes	Yes	Yes	
Rochester Stoke	Yes	Yes	Yes	
Salford Eccles	Yes	Yes	Yes	
Saltash Roadside	Yes	Yes	-	
Sandwell West Bromwich	No	Yes	Yes	Site not representative of surrounding area; may be affected by traffic in car park. Site being replaced by Birmingham Acocks Green
Sandy Roadside	Yes	Yes	-	
Scunthorpe Town	Yes	Yes	-	

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Sheffield Centre	Yes	Yes	Yes	
Sheffield Tinsley	Yes	Yes	-	
Sibton	Yes	Yes	Yes	Check sample inlets are more than 0.5m from side of enclosure/building façade.
Southampton Centre	Yes	Yes	Yes	
Southend-on-Sea	Yes	Yes	Yes	
St Osyth	Yes	Yes	Yes	
Stanford-le-Hope Roadside	Yes	Yes	-	
Stockton-on-Tees Eaglescliffe	Yes	Yes	-	
Stoke-on-Trent Centre	Yes	Yes	Yes	
Storrington Roadside	Yes	Yes	-	Not yet commissioned; microscale requirements not yet fully assessed
Sunderland Silksworth	Yes	Yes	Yes	
Thurrock	Yes	Yes	Yes	
Walsall Willenhall	Yes	Yes	Yes	
Warrington	Yes	Yes	-	
Weybourne	Yes	Yes	No	Prevailing weather conditions so near sea may affect concentrations
Wicken Fen	Yes	Yes	Yes	
Wigan Centre	Yes	Yes	Yes	
Wirral Tranmere	Yes	Yes	Yes	
Yarner Wood	Yes	Yes	Yes	
York Bootham	Yes	Yes	-	
York Fishergate	Yes	Yes	-	On central reservation which is accessed by the public and therefore the Directive is applicable

London

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Camden Kerbside	Yes	Yes	-	
Haringey Roadside	Yes	Yes	-	
London Bexley	Yes	Yes	-	
London Bloomsbury	Yes	Yes	Yes	
London Cromwell Road 2	No	Yes	-	Site on major road junction
London Eltham	Yes	Yes	Yes	
London Haringey	Yes	Yes	Yes	
London Harlington	Yes	Yes	Yes	
London Hillingdon	Yes	Yes	Yes	
London Marylebone Road	Yes	Yes	Yes	
London N. Kensington	Yes	Yes	Yes	

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
London Stanmore	Yes	Yes	-	
London Teddington	Yes	Yes	Yes	
London Westminster	Yes	Yes	Yes	
Southwark Roadside	-	-	-	Site not operational since 2006
Tower Hamlets Roadside	Yes	Yes	-	

Wales

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Aston Hill	Yes	Yes	Yes	
Cardiff Centre	Yes	Yes	Yes	
Chepstow A48	Yes	Yes	-	
Cwmbran	Yes	Yes	Yes	
Mold	Yes	-	-	Not yet commissioned; microscale requirements not yet fully assessed
Narberth	Yes	Yes	Yes	
Newport	Yes	Yes	-	
Port Talbot Margam	Yes	Yes	Yes	
Swansea Roadside	Yes	Yes	-	
Wrexham	Yes	Yes	-	

Scotland

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Aberdeen	Yes	Yes	Yes	
Aberdeen Union St Roadside	Yes	Yes	-	
Auchencorth Moss	Yes	Yes	Yes	
Bush Estate	Yes	Yes	Yes	
Dumfries	Yes	Yes	-	
Edinburgh St Leonards	Yes	Yes	Yes	
Eskdalemuir	Yes	Yes	Yes	
Fort William	Yes	Yes	Yes	
Glasgow Centre	Yes	Yes	Yes	
Glasgow City Chambers	Yes	Yes	-	Check sample inlets are more than 0.5m from side of enclosure/building façade.
Glasgow Kerbside	Yes	Yes	-	
Grangemouth	Yes	Yes	-	
Grangemouth Moray School	Yes	-	-	Not yet commissioned; microscale requirements not yet fully assessed

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Inverness	Yes	Yes	-	
Lerwick	Yes	Yes	Yes	
Peebles	Yes	-	-	Not yet commissioned; microscale requirements not yet fully assessed
Strath Vaich	Yes	Yes	Yes	

Ireland

SITE	Compliant with Annex 3 Section B: Macroscale	Compliant with Annex 3 Section C: Microscale	Compliance with Annex VIII Ozone	Comments
Armagh Roadside	Yes	-	-	Not yet commissioned; microscale requirements not yet fully assessed
Belfast Centre	Yes	Yes	Yes	
Derry	Yes	Yes	Yes	
Lough Navar	Yes	Yes	Yes	
Mace Head	Yes	Yes		Global Atmosphere site; not intended for compliance

Appendix 3

Assessment Methodology

Example-Leeds Centre

Leeds Centre is situated in an open area in Queens Square Court. It is 30 metres from major road, and 40 metres from the junction to the north-west. The site environment is shown in Figure A1, and a photograph of the site in Figure A2:

Figure A1: Aerial Photograph of the area (courtesy Google Earth)

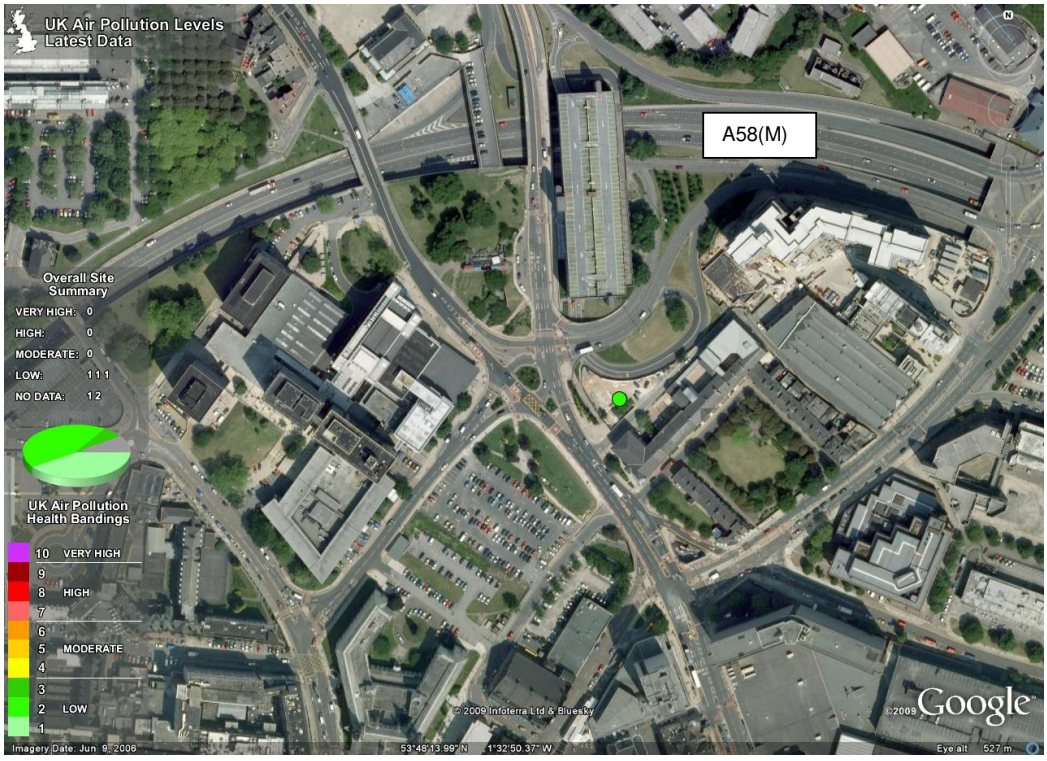

Figure A2: Photograph of Leeds Centre Site

Considering each point of the Directive given in Section 2.1 in turn:

Macroscale Requirements

Protection of human health

(a) Sampling points directed at the protection of human health shall be sited in such a way as to provide data on the following:

- *— the areas within zones and agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s),*

- *— levels in other areas within the zones and agglomerations which are representative of the exposure of the general population,*

The site is surrounded by residential and commercial premises, where people could reasonably expect to spend many hours at a time. The site is situated well within the Leeds City area, and local air quality will be influenced by a variety of activities and processes. Given the central location, pollution levels can be expected to be amongst the highest in the area, without the influence of any specific source. The Leeds General Infirmary is close by.

The site is classified as an Urban Background site.

(b) Sampling points shall in general be sited in such a way as to avoid measuring very small micro-environments in their immediate vicinity, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality for a street segment no less than 100 metre length at traffic-orientated sites and at least 250 × 250 metres at industrial sites, where feasible;

The site is in an open environment, but not focussed specifically on traffic-related emissions. It is sufficiently far from the road to ensure this.

(c) Urban background locations shall be located so that their pollution level is influenced by the integrated contribution from all sources upwind of the station. The pollution level should not be dominated by a single source unless such a situation is typical for a larger urban area. Those sampling points shall, as a general rule, be representative for several square kilometres;

As in (a) above, the measured pollution is from all urban sources in the city area. This is an area of many square kilometres. The A58(M) Inner Ring Road is 150 metres north of the site, with a daily traffic flow of approximately 93,500 vehicles per day.

(d) Where the objective is to assess rural background levels, the sampling point shall not be influenced by agglomerations or industrial sites in its vicinity, i.e. sites closer than five kilometres;

Not applicable in this case

(e) Where contributions from industrial sources are to be assessed, at least one sampling point shall be installed downwind of the source in the nearest residential area. Where the background concentration is not known, an additional sampling point shall be situated within the main wind direction;

Not applicable in this case

(f) Sampling points shall, where possible, also be representative of similar locations not in their immediate vicinity;

The site is typical of the Leeds centre area; a mixture of commercial and residential properties, some open space and major roads nearby.

(g) Account shall be taken of the need to locate sampling points on islands where that is necessary for the protection of human health.

Not applicable in this case

2. Protection of vegetation and natural ecosystems

Sampling points targeted at the protection of vegetation and natural ecosystems shall be sited more than 20 kilometres away from agglomerations or more than 5 kilometres away from other built-up areas, industrial installations or motorways or major roads with traffic counts of more than 50 000 vehicles per day, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality in a surrounding area of at least 1000 square kilometres. A Member State may provide for a sampling point to be sited at a lesser distance or to be representative of air quality in a less extended area, taking account of geographical conditions or of the opportunities to protect particularly vulnerable areas.

Account shall be taken of the need to assess air quality on islands.

Not applicable to an urban environment

Microscale Requirements

In so far as is practicable, the following shall apply:

- *the flow around the inlet sampling probe shall be unrestricted (free in an arc of at least 270°) without any obstructions affecting the airflow in the vicinity of the sampler (normally some metres away from buildings, balconies, trees and other obstacles and at least 0.5 metres from the nearest building in the case of sampling points representing air quality at the building line),*

The sampling inlet has been checked regularly at QA/QC audits, and is configured in line with these requirements. It is free from obstructions for 360 degrees, but with some shielding to the south-east due to a building 20 metres away. Some vegetation is evident around the site, which may need cutting back at some stage.

— *in general, the inlet sampling point shall be between 1.5 metres (the breathing zone) and 4 metres above the ground. Higher positions (up to 8 metres) may be necessary in some circumstances. Higher siting may also be appropriate if the station is representative of a large area,*

The inlet is approximately 4 metres from the ground.

— *the inlet probe shall not be positioned in the immediate vicinity of sources in order to avoid the direct intake of emissions unmixed with ambient air,*

Although an urban site, the sample inlet is adequately positioned away from any specific local sources (such as vehicles)

— *the sampler's exhaust outlet shall be positioned so that recirculation of exhaust air to the sampler inlet is avoided,*

— *for all pollutants, traffic-orientated sampling probes shall be at least 25 metres from the edge of major junctions and no more than 10 metres from the kerbside.,*

As described above, the site is 30m from the kerb but is not traffic-oriented. The vent from the cabin is not close to the sample inlet.

Ozone

The Leeds Centre site measures ozone, amongst other pollutants. The macroscale requirements for ozone are, for an urban site:

Away from the influence of local emissions such as traffic, petrol stations, etc.; vented locations where well mixed levels can be measured; locations such as residential and commercial areas of cities, parks (away from the trees), big streets or squares with very little or no traffic, open areas characteristic of educational, sports or recreation facilities

The site is located in a residential/commercial area away from trees, traffic and specific local sources. The site is typical of an area of several square kilometres. The area is representative of areas where significant numbers of people will be exposed for an appropriate length of time.

There are reports of building work in the area surrounding the site, and the macroscale siting requirements will need to be reviewed on completion.

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